STAT

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[redacted]

New President for [redacted] STAT

ber 13, 1964

Dear Stockholder:

Most of the major problems which have impaired the development of our Corporation these past several years have been solved, as indicated in the quarterly financial reports you have been receiving. Now, I feel, we are ready to grow in our aerospace endeavors and diversify into related, non-military areas.

To pursue this objective I have for many months sought a man with the unique combination of encompassing engineering know-how and outstanding executive leadership ability. I am happy to announce that [redacted] is such a man and he has this week been appointed President of the [redacted]

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[redacted]

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You can see that [redacted] superb engineering background coupled with his impressive management experience of a large group of divisions at [redacted] make him eminently qualified to draw our diversified divisions into a unified system engineering and manufacturing complex and maintain our progress in an increasingly competitive field.

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[redacted]

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Chairman of the Board

Declassification Review by NGA

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FOURTEENTH MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER SYSTEM

15 September 1964

1. SUMMARY

The following items were accomplished during this report period:

1.1 The driver master metrology was completed. The data indicated that the unit was out of specification. The vendor is fabricating a new negative print from the master positive and has given us a completion date of the early part of the week of 21 September.

1.2 In discussions with the coupler part vendor, [redacted] STAT the vendor indicated reticence in fabricating the coupler part and the driver at separate times. It was stated that the vendor will be sent an acceptable drive master when it becomes available. Ruling engine scheduling, costs, and efficiency were reasons mentioned. No technical reasons were given, therefore the vendor agreed to proceed with the fabrication of coupler. Based on a success schedule, the coupler is scheduled for completion on 28 to 29 September.

2. DRIVER MASTER

The driver master metrology indicated the existence of double cycle errors within a pole pair span of 30 microns peak-to-peak maximum and 22 microns peak-to-peak maximum in the 1000-2405 and 1000-2408 patterns respectively. These data include measurements of pole-pair spans taken near the center and at one end of pattern 1000-2405 and at each end of pattern 1000-2408. Spatial quadrature errors of -18 to +12 microns and -13 to +8 microns were also measured on these respective patterns.

Differences in error curves between the center and the ends were also noted. In one case, a phase reversal of the error curve was measured.

Brief discussions were held with the vendor, [redacted] and STAT the inspection report and data analysis were transmitted to him on 9 September. It appears that image growth and light source variations may be causative factors of the errors within the pole pair spans. No explanation of the pattern quadrature errors are yet available. Since the measurements on the sample indicate significantly better accuracy (see the Tenth Monthly Progress Report), i.e., eighteen out of twenty data points in a pole-pair span were within $\pm$ 1 micron and an overall peak-to-peak value of 5.4 microns, 1) better performance is possible, and 2) it appears that the vendor's process is out of control to this level of performance.

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A new print with, hopefully better process control, may reduce the pattern error within a pole pair span; however, the spatial quadrature errors would not be affected. Improvement here would probably require a generation of a new master positive. It is therefore, tentatively planned to minimize this error by use of the standard "balance" procedure which adjusts the amplitude and phases of the four energizing signals to minimize the overall system error within a pole pair span. Correction for a space quadrature error by introduction of electrical quadrature in the energizing signals has been demonstrated analytically using a simplified mathematical model. In addition, experimental correction and introduction of predictable quadrature errors by doctoring the coupler bars on 8 inch coupler discs has been verified.

3. PROGRAM SCHEDULE

3.1 The program completion continues to be affected by the driver master fabrication task. As stated in the Summary and based on a success schedule, the coupler part fabrication completion is estimated at 28 to 29 September by the Vendor.

4. PROBLEM AREAS

4.1 The driver master fabrication remains a problem. Upon fabrication completion and metrology of the new print, a complete review with the vendor will be conducted and action will be taken to 1) either continue the effort with [redacted] but with vendor correction taken to improve the process control, 2) accept his latest master with MRB buyoff of discrepancies, 3) salvage the master positive, if possible, and complete the task using another vendor. The customer will be consulted during all phases of this review to insure that the customer's interests are fully protected.

5. WORK PLANNED DURING THE NEXT REPORT PERIOD

5.1 Complete fabrication of a new driver master print and perform metrology.

5.2 Complete fabrication of coupler part. Vendor success schedule estimates 28 to 29 September as completion date.

5.3 A visit of the customer's technical representation with operations personnel is scheduled for 21 September at [redacted] Discussions pertaining to follow-on effort and a short demonstration of the deliverable electronics and the breadboard phasolver plates is planned.

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THIRTEENTH MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER SYSTEM

12 AUGUST 1964

SUMMARY

A. The following items were accomplished during this report period:

STAT 1. Driver masters from [redacted] were delivered twice during this report period. Upon preliminary inspection of the first unit, scratches, one short, and several minor discrepancies were noted. The unit was STAT returned to [redacted] the same day with a list of the discrepancies.

The second master was received on 4 August and preliminary inspection revealed no major discrepancies. The short was eliminated and the unit was relatively free of blemishes and scratches. The unit has been sent STAT to the metrology vendor, [redacted] for inspection. Accuracy within a pole pair span and spatial quadrature will be measured.

The vendor inspection completion date is 8/13/64.

PROGRAM SCHEDULE

2. The program completion continues to be affected by the driver master fabrication task. The coupler part completion date has not yet been received from the vendor, [redacted] Their plant is in a STAT vacation shutdown state until 17 August. Another attempt will be made to obtain status on that date. However, based on an earlier commitment of four weeks ARO for the driver part, and the acceptance of the driver master now in inspection, the following events on the critical path to completion remain:

Event	Completion Date
Driver Master Inspection Completed	8/13/64
STAT Driver Master Received by [redacted]	8/17/64
Driver Part Fabrication Completed	9/14/64
Driver Part Inspection Completed	9/23/64
Test Fixture Assembly Completed with Coupler and driver	10/1/64
Phase II System Tests Start	10/1/64
Phase II System Tests Completed	11/19/64
Final Report Completed	12/11/64

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This schedule indicates the system performance demonstration can be tentatively planned for some time in October. Upon confirmation of vendor commitment dates, a new schedule to completion will be transmitted to the customer.

PROBLEM AREAS

3. The driver master remains a problem until confirmation of acceptability by the inspection now in process.

WORK PLANNED DURING THE NEXT REPORT PERIOD

4.1 Completion of the driver master inspection. If the unit is acceptable it will be shipped to [redacted] for fabrication of the driver part. STAT

4.2 Confirmation of the coupler part delivery date.

4.3 Generation of a new schedule to completion based on vendor commitment dates.

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TWELFTH MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER SYSTEM

17 July 1964

SUMMARY

A. The following items were accomplished during this report period:

STAT 1. A trip to [redacted] was taken during the week of 22 June as planned. A complete review of status was made and is discussed below in detail. A driver master was received from [redacted] on Friday, 17 July which will be sent to a measurement laboratory for evaluation. STAT

STAT 2. [redacted] completed a marginally acceptable (vendor's statement) coupler during the first week in July. He determined that the temperature control in the fabrication area was malfunctioning during fabrication of the coupler. A new coupler was fabricated and we should receive the part the week of 20 July.

B. Potential Problem Areas:

STAT During the trip to [redacted] a complete review of vendor status was made. They had gone through at least 5 driver master fabrications to 23 June. The last master appeared to have only one defect, a complete cycle missing due to a flash lamp malfunction. They stated that there were no problems with parallel alignment or the step and repeat process, but they were attempting to put all the masters on a single plate, except the wide stripe down the middle which will be composited. The problem they have been wrestling with is human error in the fabrication, except for the electronic malfunction described above.

The vendor indicated that they had originally planned to automate this master generation such that the step and repeat would be done automatically. However, they were not successful in doing this and they have ended up initiating each step and repeat and triggering the flash lamp manually. Since there are 254 cycles and 4 tracks, this implies over 1000 manually initiated operations. The generation cycle is about one complete master per day if they start early in the morning. They have generated several single master cycles (using the slit process) since several plates have been worn out during their attempts to generate the final master.

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The vendor felt that unless they can accomplish the task reasonably soon, he would attempt to composite masters which have each type of driver pattern on them, since one of the previously completed units may have an acceptable driver pattern of one type. In doing so it may be difficult to hold the .0002 inch parallelism requirement between the 2 driver patterns, and the vendor was told that the effect of opening up this tolerance to not greater than .0005 inch in 10 inches would be considered. Subsequent to this visit, permission to composite was given with a relaxation of the parallelism tolerance as indicated above.

WORK PLANNED DURING THE NEXT REPORT PERIOD

1. A new schedule to completion will be generated based on vendor commitment dates for the completion of the driver master, coupler part fabrication, and driver part fabrication.

2. Upon delivery of the coupler part, metrology inspection will be made.

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ELEVENTH MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER SYSTEM

19 June 1964

SUMMARY

A. The following items were accomplished during this report period:

1. Anvil alignment was completed.

STAT 2. [redacted] has started the coupler part fabrication. According to the vendor, a success schedule (satisfactory results on the first cycle) would allow completion of the task by the end of the first week in July. This includes [redacted] metrology to verify part accuracy.

STAT

3. According to the latest information from [redacted] he has fabricated at least three driver masters and is completing a fourth unit on 6/19/64. Each of the three completed masters has a different defect.

STAT

B. Potential Problem Areas:

The successful completion of the driver master continues to pace the entire program. Latest discussions with [redacted] appear somewhat encouraging, but the driver master is still not completed. A trip is planned for the week of 22 June to review status and problem areas directly with the vendor. [redacted] has stated that the equipment is satisfactory and the problems have been with human errors.

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WORK PLANNED DURING THE NEXT REPORT PERIOD

STAT 1. Trip to [redacted] the week of 22 June to review problem areas and status of driver master fabrication.

2. Fabrication of the coupler by [redacted] will continue during this period. Estimated completion date on a success schedule is 7/3/64.

STAT

3. The next program phase is the assembly of the driver and coupler in the test fixture. This task awaits the delivery of the two units from [redacted] and [redacted] The electronics subsystem checkout was completed as reported in the tenth monthly progress report.

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TENTH MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER SYSTEM

14 May 1964

SUMMARY

A. The following items were accomplished during this report period:

1. The two 27 inch glass blanks were received and inspected by [ ] They stated that the blank intended for the coupler had too many surface imperfections to make an acceptable part, but that the blank originally intended for the guide rail would be acceptable. Since both parts are well within the flatness requirements, and the two parts have the same nominal dimensions, permission was granted to interchange the blanks. In addition, [ ] has successfully completed pattern adhesion tests on the blank.

2. [ ] shipped us the sample of the driver master stepped and repeated about 2 inches. The sample was qualitatively studied with a microscope at [ ] and then sent to the metrology vendor for quantitative measurements of a) step and repeat accuracy, b) phase displacement, and c) sine function accuracy.

The [ ] inspection revealed several obvious, gross discrepancies. [ ] stated that these discrepancies will be corrected. Evaluation of the metrology report indicated that the double-sided sinewave pattern, 1000-2408, is acceptable; but the single-sided sinewave pattern, 1000-2405, was not acceptable, due to a peak-to-peak error distribution of about 15 microns in the sine function. [ ] has discovered the source of this error to be overexposure and resultant image growth and states that it can be corrected.

The double-sided sinewave pattern had an error distribution with a peak-to-peak value of 5.4 microns. Data were obtained at 20 equal intervals within the sinusoidal span. Eighteen of the 20 data points were within a ± 1 micron band. If an effective coupler bar width of 180 degrees is assumed, graphical integration of this error distribution results in a predicted peak-to-peak systematic error within a pole-pair span of about 0.9 micron or ± 0.45 micron. However, this error level is in the glass plate master sample and does not include any additional error components which may occur in the pattern fabrication process using the glass plate master.

3. The reed and probe bracket fabrication has been completed and the unit passed inspection.

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4. The electronics subsystem checkout has been successfully completed and the two assemblies (card rack and power supply) have been packaged into a small cabinet for convenience during usage.

The tests were conducted in the temperature controlled room which will be used for overall system tests. The temperature environment was 75 °F ±1 °F.

Briefly, the maximum drift over a 40 hour period was ±15 nanoseconds (±0.15 micron equivalent). One data point was obtained at 90 hours of operation which also indicated 0.15 micron drift. The maximum jitter during this test was 20 nanoseconds or 0.2 micron equivalent.

A second test was conducted to determine jitter magnitude as a function of time. The maximum recorded phase jitter during a 48 hour interval was 30 nanoseconds or 0.3 micron equivalent. The jitter data in both tests include an inherent 10 nanosecond or 0.1 micron equivalent uncertainty resulting from counter operation.

Oscilloscope data of the Phasolver channel output stop pulse indicate a jitter value of about 10 nanoseconds or 0.1 micron equivalent.

From these tests it is concluded that the electronics contribution to overall stability is no worse than ±0.15 micron with a resolution of 0.1 to 0.2 micron.

B. Potential Problem Areas:

Successful fabrication of the driver master is still a potential problem. Although fabrication and subsequent examination of the sample provides some confidence that [redacted] can produce an acceptable master, the driver master fabrication is not yet completed. STAT

C. Program Schedule:

The driver master fabrication is still on the critical path. We have no firm vendor commitment on completion of the driver master. [redacted] moved to new quarters since completion of the sample measurements, and states that there will be a week's delay in completion. He has assured us that we have first priority. It is tentatively estimated for completion by the end of May. A program schedule based on this estimate is included. STAT

D. Electronics Subsystem Checkout:

The test results obtained on the Model 933 Linear Phasolver electronics are presented in Figures 1, 2, 3, and 4. A Model 915B-I fine channel Phasolver

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disk simulator was substituted for the Linear Phaselver plates. Sixteen point data were taken (approximately every 22.5° electrical) in intervals of every 4 hours during day and swing shifts for a period of 40 hours. A last reading was taken after the equipment was left operating over a 63 hour period. Total period of test was approximately 90 hours. The entire system was placed in a temperature controlled environment at 75°F ±1°F.

Figure 1 shows phase shift drift as a function of time. The electrical angle within a pole-pair with the greatest drift is shown. At no time did the drift from the initial reading exceed ±15 nanoseconds over the 16 points of the simulator. Maximum jitter recorded during the above stability test was 20 nanoseconds. This value includes an inherent counter uncertainty of 10 nanoseconds of jitter.

Photographs of the output stop pulse are also presented. Figure 2 shows the stop pulse with only the 270° drive amplifier output coupled to the preamplifier through a 5 pf capacitor. Figure 3 is the output stop pulse using the disk simulator. Both photographs were taken with the five times (5X) multiplier on the oscilloscope turned on. This makes the horizontal scale 20 nanoseconds/cm. The indicated jitter is about 10 nanoseconds.

A second time stability test was performed where the output of each drive amplifier was summed through a 5 pf capacitor into the preamplifier. A Hewlett Packard Model 562A printer was connected to the counter to record the counter readings. At each recording approximately 30 readings were recorded for a period of 48 hours. Figure 4 shows the maximum jitter as a function of time. The maximum jitter recorded was 30 nanoseconds.

WORK PLANNED DURING THE NEXT REPORT PERIOD

STAT

1. [redacted] has scheduled the coupler blank to go on their machine during the last week of May. It is expected that fabrication will be completed within a week after work starts. Pattern measurements will follow delivery of the unit to us.

2. Alignment of the anvil (reed and probe bracket) with the direction of travel is planned for completion.

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Figure 1

MODEL 938 PHASOLVER SYSTEM

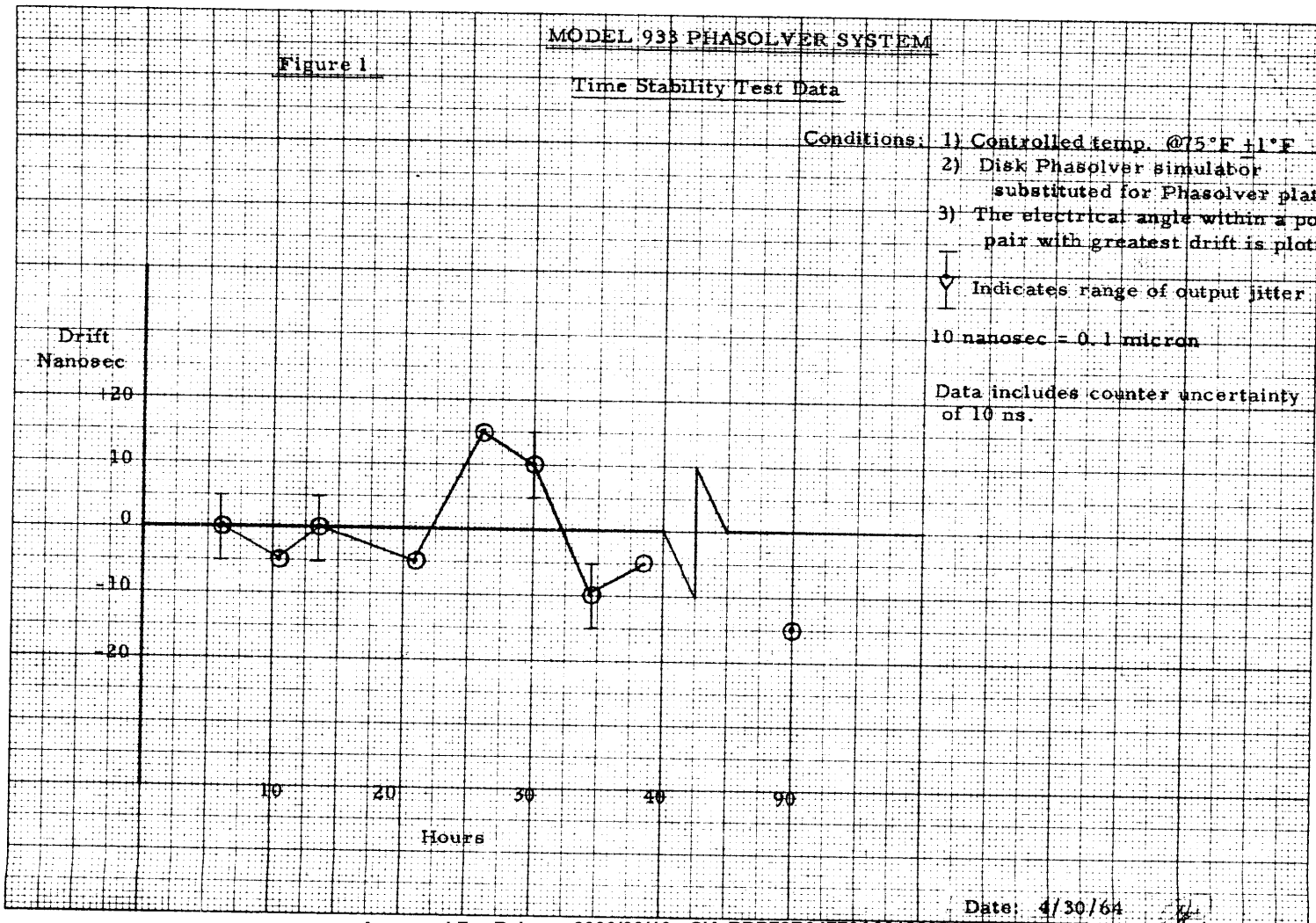
Time Stability Test Data

Conditions: 1) Controlled temp. @75°F ±1°F
2) Disk Phasolver simulator substituted for Phasolver plates
3) The electrical angle within a pole-pair with greatest drift is plotted

Indicates range of output jitter

10 nanosec = 0.1 micron

Data includes counter uncertainty of 10 ns.



Date: 4/30/64

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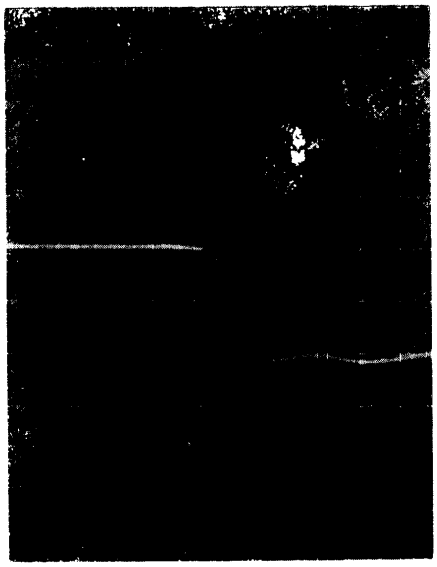

Model 933 Linear Phasolver

System Output Pulse

Figure 2

270° Drive Amplifier coupled through a 5pf capacitor to preamplifier.

Scale

Vertical = 5 volts/cm
Horizontal = 20 ns/cm

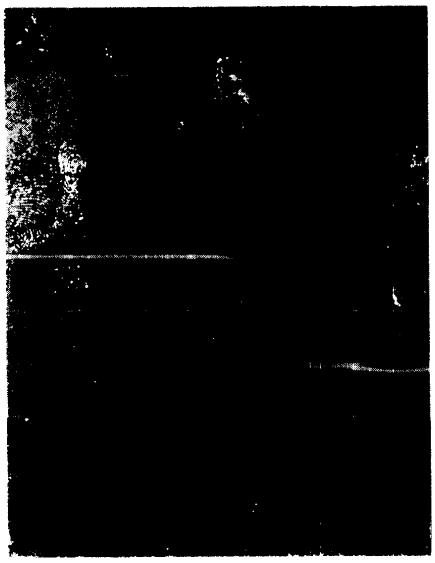

Figure 3

All drive signals through phasolver disc simulator to preamplifier.

Scale

Vertical = 5 volts/cm
Horizontal = 20 ns/cm

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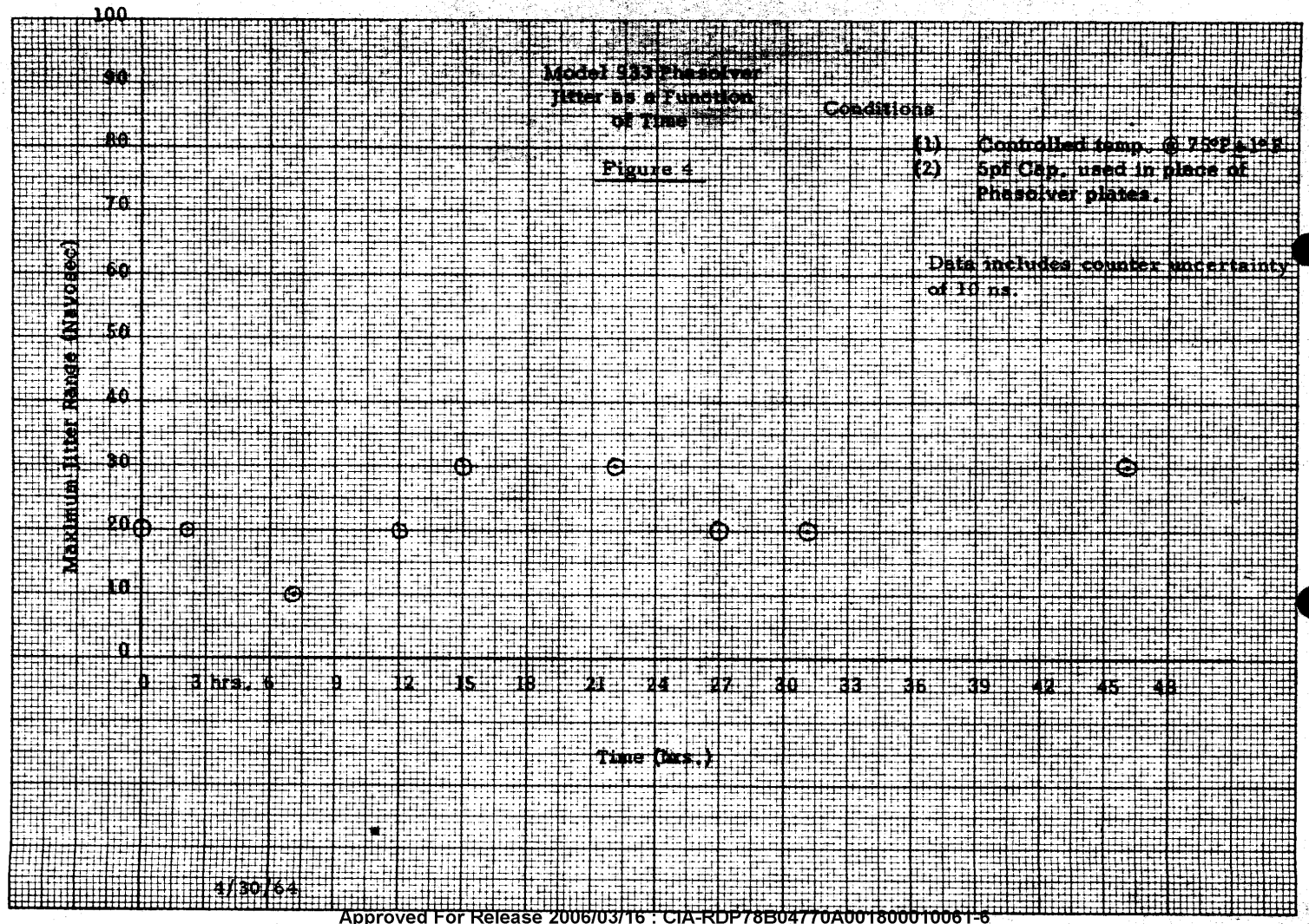

Model 533 Phasolver
Jitter as a Function
of Time

Figure 4

Conditions

(1) Controlled temp. @ 75°F ± 1°F
(2) 5pf Cap. used in place of Phasolver plates.

Data includes counter uncertainty of 10 ns.

4/30/64

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PROGRAM SCHEDULE

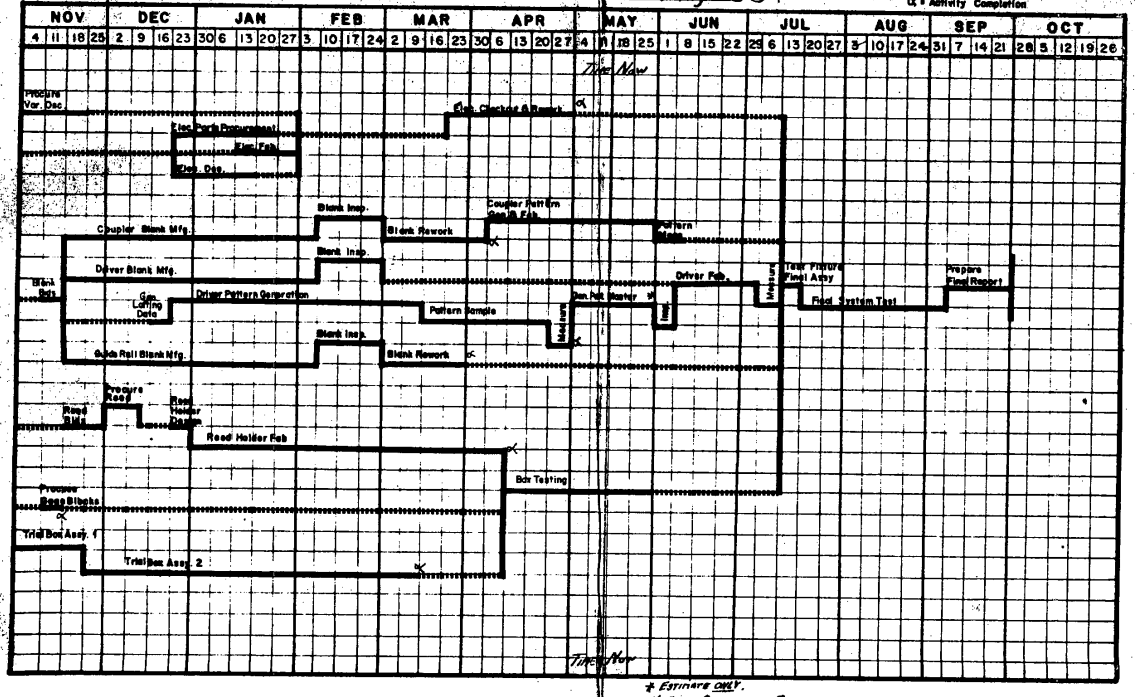
MJO No. 342-XXXXX

TITLE 935 LINEAR PHASOLVER

ISSUE DATE 14 May 1964

Mgr.

α = Activity Completion



* ESTIMATE ONLY. NO FIRM COMMITMENT TO DATE

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NINTH MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER SYSTEM

16 April 1964

SUMMARY

A. The following items were accomplished during this report period:

1. The 27 inch glass blanks for the coupler and guide rail were successfully reworked and checked by an independent laboratory. Both blanks are well within the flatness tolerance on the drawings. They have been packed and shipped
STAT separately to [redacted]

STAT 2. [redacted] did not meet the promised delivery date of 3/16/64 for the sinewave sample of the driver master. A mistake was made in generation of the artwork and this was redone. He has generated four individual sinewave masters and is now in the process of mounting them in his projector camera in order to obtain the complete Phasolver pattern quadrature. In addition, he states that the sample will contain more than one cycle so that the transition accuracy in the step-and-repeat process can be verified. This effort is obviously taking significantly longer than the original estimates. At this point, the vendor does not believe he has any fundamental problem which will not permit successful completion.

3. The closed loop gain calculations of the drive amplifiers operating at 10 kcs have been completed and indicate that satisfactory operation will be possible with no design changes. These calculations will be verified during the electronics checkout phase which will demonstrate the phase stability as a function of time of the entire electronics channel.

4. During the fabrication of the reed and probe bracket, the vendor ruined the part. A second fabrication cycle is in process and is scheduled to be completed during the week of 4/13/64.

5. The electronics fabrication has been completed and checkout has started.

B. Potential Problem Areas:

The fabrication of the driver master has become a significant problem. Apparently the complexity of the task was underestimated by the vendor, [redacted] STAT
STAT [redacted] According to the vendor, he has seen four good sinewaves, and he is now attempting to integrate these masters into a composite master within

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the drawing tolerances. Close vendor liaison will be maintained until this problem is resolved. If necessary, a trip will be taken within the next report period to [redacted] for a direct review of status and resolution of the technical problems. STAT

C. Program Schedule

The driver master fabrication is now on the critical path. The vendor states that the sample will be complete by 4/17. Based on this date, the T/C sample measurement will be completed by 4/24. If satisfactory, [redacted] will be given the go-ahead on that date. Driver master fabrication completion by [redacted] is estimated to occur on 5/11. Part fabrication completion by [redacted] on 6/5. Part measurement completion on 6/12. Final assembly of plates in test fixture on 6/19. This event indicates a 6 weeks slippage since the status shown in the program schedule of the eighth monthly progress report. STAT STAT STAT

WORK PLANNED DURING NEXT REPORT PERIOD

1. Resolve driver master fabrication problems with the vendor.

2. If the reed and probe bracket is satisfactorily completed, as now scheduled for the week of 4/13, the dry run box tests with all assembled mechanical parts and dummy plates will be started.

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E. D. Shoaltes
4/14/64

TO: ① OL/PD/ES

ATT: [redacted] STAT

② NPIC

ATT: [redacted] STAT STAT

Ref: [redacted]

Per copy attached letter - overseas condition approaching - Please advise 954 prior to ~~@~~ 10 May 64

Thanks
Dick
954

STAT [redacted]

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CA 64-31
8 April 1964

U. S. Government
Washington, D. C.

Attention: Contracting Officer

STAT Subject: [redacted]

Reference: (A) Notice of Cost Limitation, CA 64-25, 11 March 1964.
(B) Linear Phasolver Quotation ES-20793, CF 63-307, 11 April 1963.
(C) Monthly Progress Report No. 8, CA 64-29, 16 March 1964.

Gentlemen:

Pursuant to Reference (A), this Contractor has completed the analysis of this program and identified the problem areas and the cost to complete. These technical problem areas which are responsible for the increased expenditures as compared with the original estimate are as follows:

1. Inability thus far of a vendor to produce the required flatness in the driver, coupler, and guide rail blanks. Upon measurement after fabrication, it was found that the units were about 0.005 inch out of flatness. The requirement is 0.0005 inch. The units are now in a second grind and polish cycle. This problem, which was discussed in the Eighth Monthly Progress Report, has required an amount of vendor liaison by senior engineers far beyond the original estimates.

2. The design and documentation time required to insure producibility of the new driver and coupler pattern masters and finished parts was in excess of the original estimates. The complex nature of these tasks required extensive use of senior engineers throughout the conceptual design, drawing, and checking phases of this effort.

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3. Three different methods for mounting the Phasolver plates in the breadboard model test fixture were experimentally investigated. This experimental search for a satisfactory mounting method which would permit a minimum amount of handling of the plate and produce only negligible distortions in the plates (0.0001 inch) resulted in engineering labor expenditures greater than original estimates. These three methods consisted of (a) potting the coupler and guide rails in plaster; (b) using optical type wax as a holding mechanism during fabrication of optical pieces; and (c) mounting the units with simple clamps at two points 25 per cent from the ends.

The results are discussed in Reference (C). The method in (a) resulted in unacceptable distortion of the plates. The method in (b) required a significant amount of plate handling during the wax setting up period. The clamping method, (c), produced negligible distortion and appears satisfactory for the breadboard configuration.

4. Special test circuitry used in driving the HP-5275A, 100 Mc true time interval counter was discovered to be of marginal design. This test setup was required to establish the performance of these amplifiers at 10 kcs, the selected energizing frequency. The magnitude of the engineering effort expended in initial tests, and subsequent correction of the test circuitry prior to obtaining valid data, was not anticipated in the original labor cost estimate.

Assuming a very tight success schedule, and making no allowance for contingencies (such as accidental destruction of the plates), this analysis indicates a requirement for additional funds in the amount of STAT [redacted] to complete the present program. The major cost elements contributing to this anticipated overrun are as follows:

1. The total engineering hours to accomplish the original work statement have increased only 8% over the original estimate. However, there has been a significant shift in labor classification

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from lower to higher paid categories of personnel in order to resolve the technical problems described. These two factors together are responsible for nearly all of the overrun funding required.

2. Material costs are now expected to be about 6% lower than originally estimated, but this is roughly offset by an increased amount of manufacturing support labor.

3. Burden rates vary both higher and lower than those used in the original estimate, but the net effect of these variations is less than $700.00 at the total cost level.

For convenience of evaluation, Appendix A contains both (I) a comparison of the Labor Hours originally estimated in Reference (B) with those of the Revised Estimate at Completion, and (II) a Financial Analysis thereof.

Your expeditious processing of this request for additional funds will enable this Contractor to proceed with the project in a timely manner, and will be greatly appreciated. We estimate that the present funding limitation [redacted] will be exhausted on or around May 22, 1964.

STAT

Should you have questions or require additional information, please do not hesitate to contact us.

Very truly yours,

[redacted] - STAT

Vice President and General Manager

Enclosure: Appendix A

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EIGHTH MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER SYSTEM

12 March 1964

SUMMARY

A. The following items were accomplished during this report period:

1. The measurements of the glass blanks were completed. The driver blank is acceptable and was shipped to [redacted] The coupler and guide rail blanks were not acceptable. Both units had a smooth sag of about 0.005 inch at the center. The maximum allowable tolerance on flatness is 0.0005 inch. The units have been returned to the vendor and are in a second grind and polish cycle. The estimated completion date obtained from the vendor is 4/10/64. STAT

2. A status report has been obtained from [redacted] on the generation of the driver master. He states that the job is progressing "satisfactorily." The art work is done. He expects to be able to send us the sample called for in [redacted] internal specification ES-P-1178 by 3/16/64. The sample includes a sinusoidal waveform on a high resolution photographic glass plate. Precision measurements of the sinusoid coordinates will be made to verify the process integrity before authorization to proceed is given. STAT STAT

3. The reed and probe bracket are in fabrication. The vendor due date has slipped from 3/2 to 3/13.

4. The second and third trial assemblies of the box with dummy glass plates have been completed. Potting the coupler in place is not acceptable. As the plaster sets up it shrinks enough to introduce a bow of 0.0005 inch and an additional 0.0001 inch as it dries. Clamping the parts together at two points 25 per cent from the ends is acceptable, introducing no detectable distortion. (The estimated measurement error is 0.000,050 inch.)

5. The initial experimental data have been obtained on the drive amplifier and preamplifier operating at 10 kcs. It appears that the present preamplifier design will be adequate. Calculation of closed loop gain change of the drive amplifier will be made using the experimental values of forward path gain change over the temperature range 75° F to 100° F. These computed values of closed loop gain change will be used to determine the suitability of the present design.

6. The input and output filters were delivered. They were used in the tests run on the drive amplifiers and preamplifiers.

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B. Potential Problem Areas:

The coupler and guide rails remain a problem area. Both had a nearly identical smooth sag of almost 0.005"at the center. The best explanation the vendor can make is that his lapping table was moved after the acquisition of [redacted] STAT and was not checked for flatness before the work began. Secondly, there is no temperature control overnight in the new location. Before noon, the iron lapping table is cold whereas the glass is being warmed both by exposure to air and the work done in lapping.

Both of the rejected blanks are now being reworked. We have the assurance of the vendor that his table was trued up before this work began and that their air conditioning now operates all night.

C. Program Schedule:

A current program schedule is enclosed. Based on successful completion of events shown between this date and the estimated program completion date of 7/27/64, the demonstration of system performance can be tentatively planned for the week of 6/22/64. It is seen that the critical path is now on the coupler blank manufacture path because of the required rework. Both the estimated completion date and the demonstration date have slipped one week since 2/7/64 resulting from this problem.

D. Electronics:

The data obtained on the drive amplifier and preamplifier at 10 kcs are as follows:

1. Drive Amplifier

Nominal forward path gain = 540 $\frac{v}{v}$

Forward path gain change: +0.93% for 75°F to 100°F
-2.77% for 75°F to 50°F

Closed loop phase change: ~0 nanosec 75°F to 100°F
~0 nanosec 75°F to 50°F

Phase jitter: <30 nanosec 50°F to 100°F

2. Preamplifier

Forward gain change: ~ 0 $\frac{v}{v}$ 50°F to 100°F

Closed loop phase change: ~0 nanosec 75°F to 100°F
-20 nanosec 75°F to 50°F

Phase jitter: between 10 to 20 nanosec 50°F to 100°F

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WORK PLANNED DURING NEXT REPORT PERIOD

1. Complete the second grind and polish cycle (rework) on the guide and coupler blanks.

2. If the driver pattern sample is received as promised, the measurements will be made. If satisfactory, authorization to proceed will be given to [redacted] STAT

3. Completion of reed and probe bracket fabrication and inspection.

4. Design change of drive amplifier if required. Layout analog cards in rack. Prepare wire lists. Complete rack wiring. Start electronics checkout.

5. Complete driver master fabrication. Start driver fabrication.

6. Start dry run box tests with all assembled mechanical parts and dummy plates.

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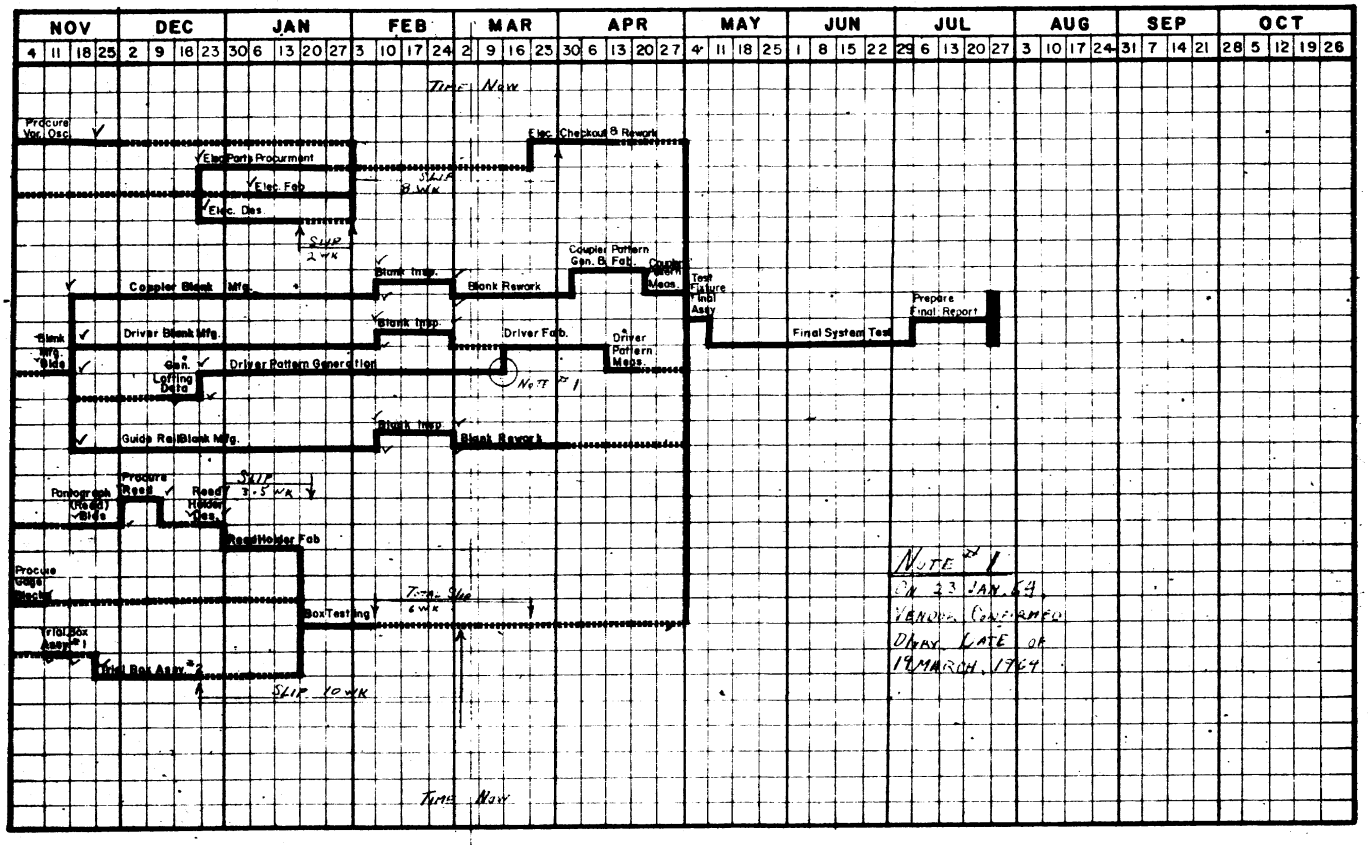
PROGRAM SCHEDULE

MJO No. 342-XXXXXX

Mgr. [ ] STAT

TITLE LINEAR PHASOLVER

ISSUE DATE 3/6/64



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SEVENTH MONTHLY PROGRESS REPORT

MODEL 933 PHASOLVER SYSTEM

11 February 1964

SUMMARY

A. The following items were accomplished during this report period:

1. The driver master pattern is in work at [redacted] and the promised delivery date is 3/19/64. STAT

2. The three glass blanks (driver, coupler, guide rail) have been delivered and are now at [redacted] being checked to print. STAT

3. The purchase order for driver fabrication has been placed with [redacted] They accepted our delivery requirement of 4 weeks after receipt of master. STAT

4. The second trial box assembly has started.

5. The 10 kcs input and output filters have been ordered. These items are the long lead time items in the electronics subsystem and pace completion of electronics fabrication. The delivery date is 3/23/64.

6. Tests on the zero crossing detector and pulse shaper circuits to verify performance at 10 kcs have been successfully completed. Results indicate 10 to 20 nanoseconds phase jitter. This is equivalent to 0.1 to 0.2 micron. It appears that no design changes are required on the circuits for 10 kcs operation.

7. Initial tests have been started on the preamplifier and drive amplifier. Open loop gain and phase measurements at laboratory ambient temperature have been obtained.

8. The reed holder design has been completed. The parts are out for fabrication bid.

B. Potential Problem Areas:

The enclosed program schedule indicates that most of the slack has been used in the electronics design, fabrication, and checkout sequence. The

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manpower conflicts have been resolved and effort on the preamp and drive amps has started; however, no further slippage can be tolerated without affecting the schedule as presented. The start of electronics checkout is shown on 3/23/64 and is paced by delivery of the filters on this date. It is expected that all fabrication will be complete and only installation of the filters on a card will be required prior to start of checkout. An effort is being made to improve the filter delivery date. The program completion date remains at 7/20/64. The experimental work completion is estimated for the week of 6/22/64. Demonstration of system accuracy and resolution can be tentatively planned for the week of 6/15/64.

C. Electronics Subsystem:

The status of the various electronics components is as follows:

a) Manual Voltage Control Circuit: Consists of a simple voltage divider. Already used in the initial controlled oscillator tests. These resistors are available.

b) 1 Mc Voltage Controlled Oscillator: Delivered. Preliminary checkout complete.

c) Squaring Amplifier: A purchased 3C card. Checked out. Used in Phase I.

d) Divide by 100, Divide by 2^{13} Circuits: 3C cards. In house. Checked out and used in Phase I.

e) Rack Wiring: Rack wired for digital cards only. Not checked out.

f) Filters: Filters have been ordered. Vendor delivery date is 3/23/64. An attempt is being made to improve this date.

g) Buffers: Fabrication is complete on filter card. Circuits are checked out and were used in Phase I.

h) Zero Crossing Detector Circuit and Pulse Shaper: Circuits are fabricated and have been tested at 10 kcs and laboratory ambient temperature. Phase jitter of 10-20 nanoseconds has been measured. These circuits appear to have satisfactory operation at 10 kcs and no design changes are planned.

i) Counter Drive: Circuits are fabricated and checked out. They were used in Phase I.

j) Drive Amplifiers and Preamplifier: Open loop gain and phase measurements have been obtained at laboratory ambient temperature conditions. Open loop and closed loop data will now be obtained over the range 50 to

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100°F. After review of these data, design changes will be incorporated, if required.

WORK PLANNED DURING NEXT REPORT PERIOD

1. Complete second trial box assembly. Make measurements on dummy plates to determine if mounting technique in plaster is satisfactory.

2. Complete tests on drive amps and preamp. Incorporate design changes, if required, and verify performance of these modified circuits.

3. Start reed holder fabrication.

4. If the measurements on the glass blanks indicate satisfactory quality, the blanks will be sent to [redacted] for the next step in the manufacturing sequence. If further grinding or polishing is required, this effort will be discussed with [redacted]

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